

General Conditions

The estimate of the general conditions includes the cost of the project administration, project equipment, temporary construction and general operations. The administration costs are broken down into management and supervision, engineering and safety, and office to monitor and manage the design and construction. The project equipment includes the cost of purchases, transportation and other miscellaneous expenses. The estimate for temporary construction includes buildings, utilities, facilities, and protection. Finally, the general operation costs include permits, bonds, utilities, security, testing, and cleanup.

Structural System

To develop the most accurate take off quantities the provided plans were modeled by MACH 5 Modeling Department using Revit. Given the complexity of the structural system modeling the structure in 3D is the best method to perform accurate estimations. Using the Revit database of information a schedule of beams and columns was automatically created. These schedules were used in conjunction with RS Means to calculate the structural system cost.

Time Dependent Durations

Construction on the Material & Life Science Building II is set to begin on October 1, 2008 and complete by August 1, 2010. The construction schedule is 22 months long or approximately 96 weeks. These durations were used in many of the time dependent line items. The estimated preconstruction duration is approximately 5.5 months therefore the total preconstruction and construction duration is 27.5 months. The following chart shows the administrative personnel and their contributions to this project.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Project Staff | % on Precon | % on Construction | Total % on Job | Resulting Weeks |
| Project Manager | 100 | 50 | 60 | 57.6 |
| Assistant Project Manager | 100 | 50 | 60 | 57.6 |
| Superintendent | 25 | 100 | 85 | 81.6 |
| Assistant Superintendent | 25 | 100 | 85 | 81.6 |
| Assistant Superintendent | 25 | 100 | 85 | 81.6 |
| Field Survey/Engineer | 25 | 100 | 85 | 81.6 |
| Project Engineer | 75 | 50 | 55 | 52.8 |
| Office Engineer | 75 | 50 | 55 | 52.8 |
| Field Engineer | 25 | 50 | 45 | 43.2 |
| Office Manager | 25 | 50 | 45 | 43.2 |
| Timekeeper | 25 | 50 | 45 | 43.2 |
| Secretary | 25 | 50 | 45 | 43.2 |

CPM Schedule

The durations for the schedule have been calculated using RS Means Cost Data in conjunction with industry experienced assumptions. The quantity of material was measured from the provided building documentation and used with the daily outputs from RS Means Cost Data to calculate the number of days to complete a task. These calculations can be found in Appendix A. There will be a significant amount of time dedicated towards the foundation of the building, approximately 170 days, including excavation, piling and concrete work. However the single largest amount of time will be taken to install MEP. Finally, the schedule shows the project completion on July 29.







MACH 5 decided that building a detailed Revit model would be a good approach to get accurate quantity take offs. (Detailed quantity take off sheets are available upon request to MACH 5). RS Means Cost Data was used to gather prices for all of the quantities. During this process many assumptions were made because of the lack of depth in RS Means. These assumptions are noted in the tables below. The overall price of the super structure of the building is $8,309,800.

Estimate Summary: Quantity Cost

Structural Steel Members 3103 Pieces and 2803 Tons $6,954,743

Floor and Roof Decking 159,661 sq ft $752,003

Concrete Slab on Deck 5468.5 CY $616,421

Concrete Slab on Grade 5,157 CY $737,639.9

Reinforced Wire Mesh 312.31 Tons $443,229

Steel Column Estimate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Member**  **Size** | **Quantity** | **Total**  **Length**  **(decimal)** | **$/ft** | **Cost** | **Tonnage** |
|  |  |  |  |  |  |
| W10X49 | 17 | 410.00 | $ 54.19 | $ 22,217.90 | 10.05 |
| W14X43 | 17 | 306.00 | $ 49.88 | $ 15,263.28 | 6.58 |
| W14X53 | 2 | 54.00 | $ 61.48 | $ 3,319.92 | 1.43 |
| W14X61 | 163 | 3,826.00 | $ 70.76 | $ 270,727.76 | 116.69 |
| W14X68 | 74 | 1,107.50 | $ 78.88 | $ 87,359.60 | 37.66 |
| W14X74 | 23 | 632.00 | $ 87.37 | $ 55,217.84 | 23.38 |
| W14X82 | 28 | 718.00 | $ 95.12 | $ 68,296.16 | 29.44 |
| W14X90 | 160 | 3,022.00 | $ 104.40 | $ 315,496.80 | 135.99 |
| W14X99 | 16 | 210.00 | $ 114.84 | $ 24,116.40 | 10.40 |
| W14X109 | 8 | 188.00 | $ 126.44 | $ 23,770.72 | 10.25 |
| W14X120 | 10 | 240.00 | $ 138.96 | $ 33,350.40 | 14.40 |
| W14X145 | 8 | 136.00 | $ 168.20 | $ 22,875.20 | 9.86 |
| W14X159 | 10 | 200.00 | $ 184.44 | $ 36,888.00 | 15.90 |
| W14X176 | 8 | 152.00 | $ 202.18 | $ 30,731.36 | 13.38 |
| W14X193 | 9 | 156.00 | $ 223.88 | $ 34,925.28 | 15.05 |
| W14X211 | 5 | 100.00 | $ 244.76 | $ 24,476.00 | 10.55 |
| W14X257 | 2 | 80.00 | $ 298.12 | $ 23,849.60 | 10.28 |
| W14X283 | 72 | 1,352.00 | $ 328.28 | $ 443,834.56 | 191.31 |
| W14X311 | 4 | 80.00 | $ 360.76 | $ 28,860.80 | 12.44 |
| W14X370 | 8 | 144.00 | $ 429.20 | $ 61,804.80 | 26.64 |
| W14X550 | 16 | 312.00 | $ 638.00 | $ 199,056.00 | 70.98 |
|  | **TOTAL** |  |  | **TOTAL** | **TOTAL** |
|  | 660 |  |  | $ 1,826,438.38 | 772.64 |

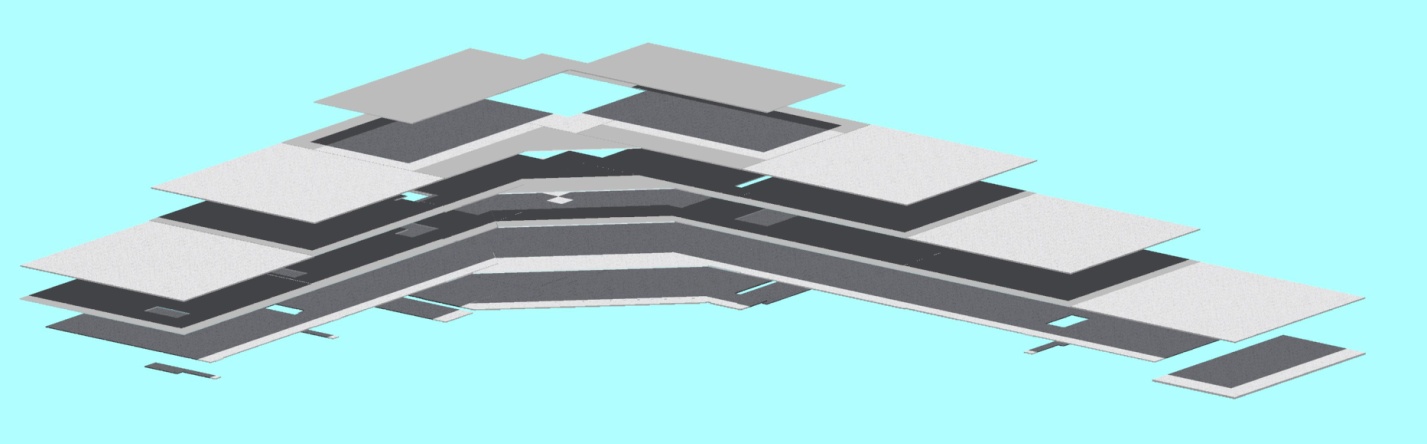
Steel Beams and Bracing Estimate

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Member**  **Size** | **Quantity** | |  | **Total**  **Length**  **(english)** | **Total**  **Length**  **(decimal)** | **Unit Cost**  **$/ft** | | **Cost** | **Tonnage** |
| W8X10 | 6 | |  | 65' - 10 3/32" | 65.84 | $ 17.65 | | $ 1,162.08 | 0.33 |
| W10X49 | 60 | |  | 1164' - 10 21/32" | 1,164.89 | $ 62.42 | | $ 72,712.43 | 28.54 |
| W14X22 | 89 | | **'** | 1549' - 10 7/8" | 1,549.91 | $ 33.34 | | $ 51,674.00 | 17.05 |
| W14X43 | 2 | |  | 49' - 4 15/16" | 49.41 | $ 53.20 | | $ 2,628.61 | 1.06 |
| W14X68 | 38 | |  | 964' - 10 13/32" | 964.87 | $ 76.63 | | $ 73,937.99 | 32.81 |
| W14X74 | 10 | |  | 106' - 0 25/32" | 106.07 | $ 88.51 | | $ 9,388.26 | 3.92 |
| W14X90 | 50 | |  | 1255' - 2 23/32" | 1,255.23 | $ 106.14 | | $ 133,230.11 | 56.49 |
| W14X99 | 2 | | **<** | 58' - 6 7/32" | 58.52 | $ 106.14 | | $ 6,211.31 | 2.90 |
| W14X109 | 6 | | **^** | 171' - 11 29/32" | 171.99 | $ 140.29 | | $ 24,128.48 | 9.37 |
| W14X145 | 36 | | **\*** | 1318' - 0 31/32" | 1,318.08 | $ 171.10 | | $ 225,523.49 | 95.56 |
| W14X159 | 7 | | **\*** | 263' - 8 21/32" | 263.72 | $ 187.62 | | $ 49,479.15 | 20.97 |
| W14X176 | 6 | | **\*** | 170' - 7 9/32" | 170.61 | $ 207.68 | | $ 35,432.28 | 15.01 |
| W14X193 | 40 | | **\*** | 1133' - 3 11/32" | 1,133.28 | $ 227.74 | | $ 258,093.19 | 109.36 |
| W14X211 | 115 | | **\*** | 2541' - 11 3/8" | 2,541.95 | $ 248.98 | | $ 632,894.71 | 268.18 |
| W14X233 | 3 | | **\*** | 84' - 10 25/32" | 84.90 | $ 274.94 | | $ 23,342.41 | 9.89 |
| W14X257 | 24 | | **\*** | 1128' - 0" | 1,128.00 | $ 303.26 | | $ 342,077.28 | 144.95 |
| W14X283 | 22 | | **\*** | 498' - 7 17/32" | 498.63 | $ 333.94 | | $ 166,512.50 | 70.56 |
| W14X370 | 6 | | **\*** | 137' - 5 5/32" | 137.43 | $ 436.60 | | $ 60,001.94 | 25.42 |
| W14X398 | 14 | | **\*** | 322' - 1 5/32" | 322.10 | $ 469.64 | | $ 151,271.04 | 64.10 |
| W14X426 | 4 | | **\*** | 86' - 10 1/4" | 86.85 | $ 502.68 | | $ 43,657.76 | 18.50 |
| W14X455 | 5 | | **\*** | 144' - 5 19/32" | 144.47 | $ 536.90 | | $ 77,565.94 | 32.87 |
| W16X26 | 29 | |  | 638' - 0" | 638.00 | $ 33.34 | | $ 21,270.92 | 8.29 |
| W16x31 | 37 | |  | 814' - 0" | 814.00 | $ 39.23 | | $ 31,933.22 | 12.62 |
| W16X36 | 10 | |  | 227' - 4 31/32" | 227.42 | $ 42.49 | | $ 9,663.08 | 4.09 |
| W18X35 | 21 | |  | 422' - 1 9/16" | 422.13 | $ 44.63 | | $ 18,839.66 | 7.39 |
| W18X40 | 80 | |  | 1759' - 10 15/32" | 1,759.87 | $ 50.13 | | $ 88,222.28 | 35.20 |
| W18X71 | 1 | |  | 22' - 0" | 22.00 | $ 90.98 | | $ 2,001.56 | 0.78 |
| W18X76 | 30 | |  | 660' - 0" | 660.00 | $ 90.98 | | $ 60,046.80 | 25.08 |
| W21X44 | 716 | |  | 15608' - 9 1/8" | 15,608.76 | $ 54.13 | | $ 844,902.18 | 343.39 |
| W21X50 | 52 | |  | 1143' - 1 11/16" | 1,143.14 | $ 61.13 | | $ 69,880.15 | 28.58 |
| W21X68 | 78 | |  | 1669' - 0 1/16" | 1,669.01 | $ 81.25 | | $ 135,607.06 | 56.75 |
| W24X55 | 403 | |  | 8830' - 4 1/8" | 8,830.34 | $ 66.44 | | $ 586,687.79 | 242.83 |
| W24X62 | 8 | |  | 440' - 4 17/32" | 440.38 | $ 74.44 | | $ 32,781.89 | 13.65 |
| W24X68 | 45 | |  | 970' - 3 21/32" | 970.30 | $ 80.94 | | $ 78,536.08 | 32.99 |
| W24X76 | 43 | |  | 946' - 0 7/32" | 946.02 | $ 89.94 | | $ 85,085.04 | 35.95 |
| W24X84 | 74 | |  | 1638' - 5 25/32" | 1,638.48 | $ 99.07 | | $ 162,324.21 | 68.82 |
| W24X162 | 4 | | **-** | 88' - 0" | 88.00 | $ 198.14 | | $ 17,436.32 | 7.13 |
| W27X84 | 20 | |  | 466' - 7 23/32" | 466.64 | $ 98.65 | | $ 46,034.04 | 19.60 |
| W30X90 | 6 | |  | 203' - 10 15/32" | 203.87 | $ 116.16 | | $ 23,681.54 | 9.17 |
| W36X150 | 3 | |  | 93' - 4 1/16" | 93.34 | $ 173.21 | | $ 16,167.42 | 7.00 |
| W40X149 | 10 | | **@** | 219' - 4 25/32" | 219.40 | $ 173.21 | | $ 38,002.27 | 16.35 |
| W40X167 | 4 | |  | 88' - 0" | 88.00 | $ 196.29 | | $ 17,273.52 | 7.35 |
| W44X230 | 8 | |  | 176' - 0" | 176.00 | $ 263.29 | | $ 46,339.04 | 20.24 |
| **Special Shapes ~** | | |  |  |  | **$/each** | |  |  |
| HSS10X8X.250 | | 72 |  |  |  | $ 1,179.00 | | $ 84,888.00 | - |
| HSS10X8X.3125 | | 2 |  |  |  | $ 1,179.00 | | $ 2,358.00 | - |
| HSS12X3X.250 | | 7 |  |  |  | $ 1,179.00 | | $ 8,253.00 | - |
| HSS12X6X.500 | | 55 |  |  |  | $ 1,179.00 | | $ 64,845.00 | - |
| HSS12X8X.250 | | 2 |  |  |  | $ 1,179.00 | | $ 2,358.00 | - |
| HSS12X8X.375 | | 18 |  |  |  | $ 1,179.00 | | $ 21,222.00 | - |
| HSS12X8X.500 | | 52 |  |  |  | $ 1,179.00 | | $ 61,308.00 | - |
| HSS12X8X.625 | | 2 |  |  |  | $ 1,179.00 | | $ 2,358.00 | - |
| HSS12X8X.3125 | | 6 |  |  |  | $ 1,179.00 | | $ 7,074.00 | - |
|  | | **TOTAL** |  |  |  |  | | **TOTAL** | **TOTAL** |
|  | | 2443 |  |  |  |  | | $5,128,305.03 | 2,031.07 |
|  | |  |  |  |  |  | |  |  |
|  | | NOTES: |  |  |  |  | |  |  |
|  | | ' | assume 14x26 | |  |  | |  |  |
|  | | < | assumed 14x90 | |  |  | |  |  |
|  | | ^ | assume 14X120 | |  |  | |  |  |
|  | | \* | assume avg ratio of cost to weight to be 1.18 | | | | |  |  |
|  | | - | assume its 2x cost of W24X84 | | | |  |  |  |
|  | | @ | assumed closest W36size | | | |  |  |  |
|  | | ~ | no data for HSS shapes => assume HS12x8x.5x16 | | | | |  |  |

Floor Assembly Estimate

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Assembly** | **Area** | **Volume** | **Decking Price** | **Total Deck Cost** | **Concrete Price** | **Total Concrete Cost** | **Rebar** | **Rebar Price** | **Total Rebar Cost** | **Rebar Weight** |
| **Code** | **(Revit)** |  | **$/ Sq ft** | **$** | **$/SQ FT** | **$** | **Tons** | **$/Ton** | **$** | **lb/sq ft** |
| S1 | 40,956 | 1169.26 | $4.71 | $192,902.76 | $2.74 | $112,219.44 | 30.80 | $1,405.00 | $43,272.47 | 1.50 |
| S2 | 58,631 | 2352.48 | $4.71 | $276,152.01 | $5.01 | $293,741.31 | 39.17 | $1,405.00 | $55,027.54 | 1.34 |
| S3 | 60,074 | 1946.83 | $4.71 | $282,948.54 | $3.52 | $211,460.48 | 20.69 | $1,405.00 | $29,069.57 | 0.69 |
|  | 159,661 | 5468.57 |  | $752,003.31 |  | $617,421.23 | 90.65 |  | $127,369.58 |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Slab 1 | 165,677 | 3068.09 | - | - | $2.74 | $453,954.98 | 124.59 | $1,425.00 | $177,539.47 | 1.50 |
| Slab 2 | 5,949 | 146.9 | - | - | $3.52 | $20,940.48 | 6.20 | $1,425.00 | $8,841.85 | 2.09 |
| Slab 3 | 30,136 | 1116.15 | - | - | $5.01 | $150,981.36 | 45.26 | $1,425.00 | $64,501.59 | 3.00 |
| Slab 4 | 11,154 | 826.19 | - | - | $10.02 | $111,763.08 | 45.60 | $1,425.00 | $64,976.51 | 8.18 |
|  | 212,916 | 5157.33 |  |  |  | $737,639.90 | 221.66 |  | $315,859.42 |  |
|  |  |  |  |  |  |  |  |  |  |  |
| **TOTAL** |  |  |  | **$752,003.31** |  | **$1,355,061.13** | **312.31** |  | **$443,229.00** |  |

Examples of How Revit was Used for Take Offs

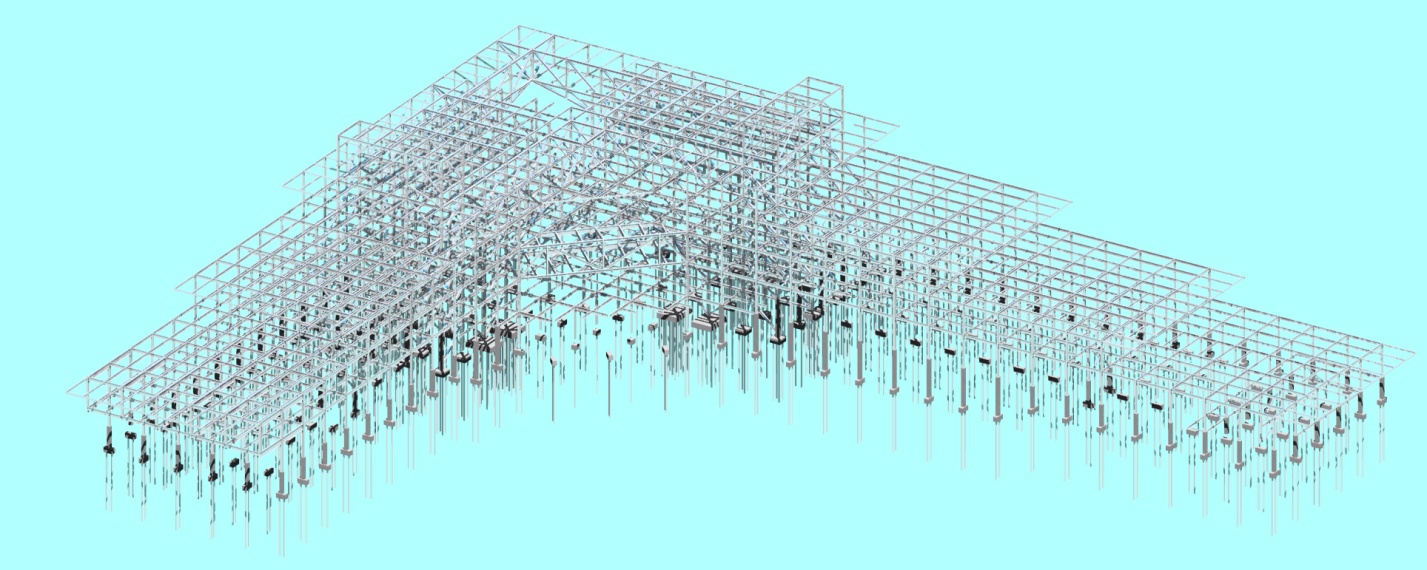


Floor Assemblies from Revit

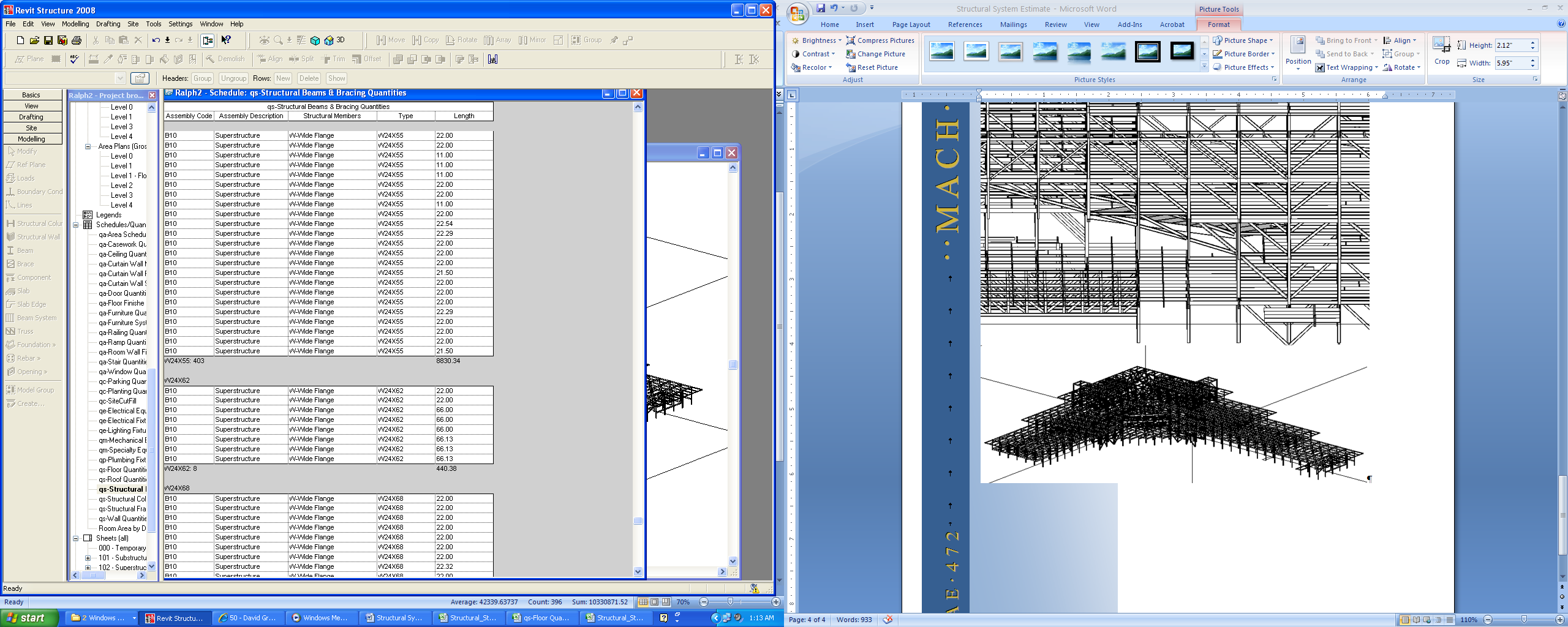


Example of Detail Level in Revit Model

(includes Bracing and Beams all to proper AISC sizes and standards)



Structural Column, Beams, and Bracing Above Grade from Revit



Example of Take-Off of Steel Beams From Revit